Inter (Part-I) 2018

Chemistry	Group-I	PAPER: I
Time: 2.40 Hours	(SUBJECTIVE TYPE)	Marks: 68

SECTION-I

2. Write short answers to any EIGHT (8) questions: (16)

(i) How is the law of conservation of mass obeyed during stoichiometric calculations?

Ans Stoichiometric calculations are those in which balance chemical equation is used. Balanced chemical equation means that masses of reactant and product are same. This means that law of conservation of mass is obeyed. Otherwise, no calculation is correct.

(ii) How do many chemical reactions take place in our surroundings involve the limiting reactant?

Ans In our surrounding, many chemical reactions are taking place which involve oxygen. In these reactions, oxygen is always in excess quantity while, other reactants are in lesser amount. Thus, other reactants act as limiting reactants.

(iii) How do no individual Ne atom in the sample of the element has mass of 20.18 a.m.u.?

Ans Neon has three isotopes $^{20}_{10}Ne$, $^{21}_{10}Ne$, $^{22}_{10}Ne$. The average atomic mass of neon is 20.18 amu. Atomic mass depends upon the number of possible isotopes and their natural abundance.

$$\text{Average atomic mass} = \frac{(m_1 \times a) + (m_2 \times b) + (m_3 \times c)}{100}$$

Where 'a', 'b' and 'c' are the natural abundance of isotopes. Now, by putting the values:

$$= \frac{(20 \times 90.92) + (21 \times 0.26) + (22 \times 8.82)}{100}$$

$$= 20.18 \text{ a.m.u.}$$

(iv) Define qualitative analysis and quantitative analysis of a compound.

Ans **Qualitative analysis:**

The detection and identification of elements in a compound is called qualitative analysis.

Quantitative Analysis:

The determination of amount or percentage of different elements in a compound is called quantitative analysis.

(v) What is difference between Gooch's crucible and sintered glass crucible?

Ans

Gooch Crucible	Sintered Glass Crucible
1. It is made of porcelain.	1. It is made of glass.
2. It is a porous base.	2. In its base, sintered glass disc is sealed.
3. Its base needs to cover with a filter paper or an asbestos mat.	3. There is no need to cover the base with filter paper or asbestos mat.
4. To filter the reactive solutions, base is covered with asbestos mat.	4. There is no need of any alteration.

(vi) Why is SO_2 comparatively non-ideal at 273 K but behaves ideally at 327°C?

Ans Increasing the temperature, increases the intermolecular spaces and decreases the intermolecular forces, thus, increasing ideality, so at high temperature of 327°C, SO_2 is ideal as compared to 273 K.

(vii) Derive expression of molecular mass of a gas by using general gas equation.

Ans This equation shows that if we have any quantity of an ideal gas, then the product of its pressure and volume is equal to the product of number of moles, general gas constant and absolute temperature. This equation is reduced to Boyle's law, Charles' law and Avogadro's law, when appropriate variables are held constant.

$PV = n RT$, when T and n are held constant,

$PV = k$ (Boyle's law)

$V = R\frac{nT}{P}$, when P and n are held constant,

$V = kT$ (Charles' law)

$V = R\frac{nT}{P}$, when P and T are held constant,

$V = kn$ (Avogadro's law)

For one mole of a gas, the general gas equation is:

$$PV = RT \quad \text{or} \quad \frac{PV}{T} = R$$

It means that ratio of PV to T is a constant quantity (molar gas constant):

Hence,

$$\frac{P_1V_1}{T_1} = R \qquad \frac{P_2V_2}{T_2} = R$$

Therefore,

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

(viii) Where do natural plasma and artificial plasma exist?

Ans Artificial plasma can be created by ionization of a gas, as in neon signs. Plasma at low temperature is hard to maintain because outside a vacuum, low temperature plasma react rapidly with any molecular it encounters.

Natural plasma exists only at very high temperature, or low temperature vacuums.

(ix) Calculate pH of 10^{-4} mole dm^{-3} solution of HCl.

Ans

$$HCl \rightleftharpoons H^+ + Cl^-$$

10^{-4} mol. dm^{-3} $\rightleftharpoons$ 0 + 0 t = 0 sec

0 $\rightleftharpoons$ 10^{-4} mol. dm^{-3} + 10^{-4} mol. dm^{-3} t = equilibrium

$[H^{\oplus}] = 10^{-4}$

pH = ?

$pH = -\log [H^{\oplus}]$

$pH = -\log 10^{-4}$

$pH = +4 \log 10$

$\boxed{pH = 4}$

(x) Why does catalyst affect the equilibrium constant?

Ans A catalyst cannot affect the equilibrium constant of a reaction but it helps the equilibrium to be established earlier. The rate of forward and backward steps are increased equally.

(xi) Write the relationship of K_p and K_c.

Ans Let the general reaction be,

$$aA + bB \rightleftharpoons cC + dD$$

When the concentration of reactants and products are in mole^{-3}, then equilibrium constant is written as:

$$K_c = \frac{[C]^c\,[D]^d}{[A]^a\,[B]^b}$$

or $$K_c = \frac{C^cC.C^dD}{C^aA.C^bB} \qquad (1)$$

When the concentration are expressed in terms of partial pressure (P) for gaseous reactant and product, then,

$$K_P = \frac{P^cC.P^dD}{P^aA.P^bB} \qquad (2)$$

When the concentration are expressed in term of mole fractions (X), then,

$$K_c = \frac{X^cC.X^dD}{X^aA.X^bB} \qquad (3)$$

The relation between these equilibrium constants are as follows:

$$K_p = K_c\,(RT)^{\Delta n}$$

(xii) Why can solid ice at 0°C be melted by applying pressure without supply of heat from outside?

Ans According to Boyle's law, pressure is inversely proportional to volume keeping temperature constant. So, at 0°C, if pressure is applied to a solid ice, volume will be decreased.

When water freezes, it occupies 9% more space. Solid ice occupies more volume than liquid water. When pressure is applied to solid ice at 0°C, keeping temperature constant, it melts, and volume is decreased.

3. Write short answers to any EIGHT (8) questions: (16)

(i) Define isomorphism and polymorphism.

Ans **Isomorphism:**

It is a phenomenon in which two different substances exist in the same crystalline form. These different substances are isomorphs.

e.g., $NaNO_3$, KNO_3 ⟶ rhombohedral

Zn , Cd ⟶ hexagonal

Cu, Ag ⟶ cubic

Polymorphism:

It is a phenomenon in which a compound exists in more than one crystalline forms. That compound is polymorphic, and these forms are called polymorphs of each other.

e.g., $AgNO_3$, $CaCO_3$.

(ii) How are liquid crystals used to locate veins, arteries, infections and tumors?

Ans Liquid crystalline substances are used to locate veins, arteries, infections and tumors. The reason is that these parts of the body are warmer than the surrounding tissues. Specialists can use the techniques of skin thermography to detect blockages in veins and arteries. When a layer of liquid crystal is painted on the surface of the breast, a tumor shows up as a hot area which is coloured blue. This technique has been successful in the early diagnosis of breast cancer.

(iii) Lower alcohols are soluble in water but hydrocarbons are insoluble. Give reason.

Ans Lower alcohols are soluble in water because they have tendency to form hydrogen bonds but hydrocarbons are not soluble in water because they are non-polar compounds and there are no chances of hydrogen bonding between water and hydrocarbon molecules.

(iv) Why electrical conductivity of the metals decrease by increasing temperature?

Ans In metals, there are free electrons at normal temperature. So, when we increase temperature it resistively increases, so, conductivity decreases.

(v) Why is dipole moment of CO_2 is zero but that of CO is 0.12 D?

Ans In case of CO_2 and molecules with linear geometry, the two dipole moment cancelled out by each other and result is zero. There are molecules like CO with dipole moment. These dipole moment cannot cancel each other due to non-linear (angular) geometry. Hence, resultant dipole moment is not zero and in CO, it is 0.12 D.

(vi) Why do ionic compounds not exhibit the phenomenon of isomerism but covalent compounds do?

Ans The ionic compound involve electrostatic lines of forces between oppositely charged ions. Therefore, such bonds are

non-rigid and non-directional. Because of this, ionic compounds do not exhibit the phenomenon of isomerism.

(vii) On what factors, strength of bond depends upon?

Ans Bond energy is a measure of the strength of a bond. The strength of a bond depends upon the following factors:

(i) Electronegativity difference of bonded atoms.
(ii) Sizes of the atoms.
(iii) Bond length.

(viii) Differentiate between coordinate covalent bond and covalent bond.

Ans In a covalent bond, both atoms share a pair of electrons whereas in a coordinate covalent bond, only one atom shares a pair of electrons with another atom.

(ix) What are exothermic and endothermic reactions? Give examples.

Ans Those chemical reactions which release the heat are called ***exothermic*** reactions, while, those chemical reactions which absorb the heat are called ***endothermic*** reactions.

(x) Define enthalpy of solution. Give examples.

Ans The standard enthalpy of a solution is the amount of heat absorbed or evolved when one mole of a substance is dissolved in so much solvent that further dilution results in no detectable heat change.

Example:

Enthalpy of solution of ammonium chloride is +16.2 kJ mol^{-1} and that of sodium carbonate is –25.0 kJ mol^{-1}.

(xi) What are zeotropic and azeotropic mixtures?

Ans **Zeotropic:**

The liquid mixtures which distil with a change in composition are called as zeotropic mixtures.

Azeotropic mixtures:

Such liquid mixtures, which distil without change in composition, are called azeotropic mixtures.

(xii) What is fractional crystallization?

Ans Fractional crystallization is the separation of solid substances from their solutions one by one depending upon their solubilities at different temperatures.

4. Write short answers to any SIX (6) questions: (12)

(i) What particles are formed by the decay of free neutron? Give equation.

Ans Free neutron decays into a proton ($^{1}_{+}P$) with the emission of an electron ($^{0}_{-1}e$) and a neutrino ($^{0}_{0}n$).

Equation:

$$^{1}_{0}n \longrightarrow {}^{1}_{+1}P + {}^{0}_{-1}e + {}^{0}_{0}n$$

(ii) Justify that the distance gaps between different orbits go on increasing from lower to the higher orbits.

Ans Consider the following equation:

$$r = \frac{\varepsilon_o n^2 h^2}{\pi m Ze^2}$$

For H-atom Z = 1

$$r = \frac{\varepsilon_o n^2 h^2}{\pi m e^2} \times n^2$$

Since, $\frac{\varepsilon_o h^2}{\pi m e^2} = 0.529^o A$

$$r = 0.529^o A(n^2)$$

By putting the values of 'n' as 1, 2, 3, 4, . . . the radii of orbits of hydrogen atom are:

$n = 1$

$r_1 = 0.529^o A \times (1) = 0.529^o A$

$n = 2$

$r_2 = 0.529^o(A) \times (2)^2 = 2.11^o A$

$n = 3$

$r_3 = 0.529^o A \times (3)^2 = 4.75^o A$

$n = 4$

$r_4 = 0.529^o A \times (4)^2 = 8.4 A^o$

$n = 5$

$r_5 = 0.529^o A (5)^2 = 13.22^o A$

Gaps between these orbits can be calculated as:

$r_2 - r_1 = 1.581^o A$

$r_3 - r_2 = 2.64^o A$

$r_4 - r_3 = 3.65°A$

$r_5 - r_4 = 4.82°A$

The comparison of radii shows that the gaps between orbits of H-atom go on increasing as we move from first orbit to higher orbits. It reflects that orbits are not equally spaced.

(iii) What is Zeeman effect?

Ans When the excited atoms of hydrogen are placed in a magnetic field, its spectral lines are further split up into closely spaced lines. This type of splitting of spectral lines is called Zeeman's effect.

(iv) Distribute electrons in orbitals of: (a) $_{24}Cr$ (b) $_{35}Br$

Ans (a) $_{24}Cr$:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$

(b) $_{35}Br$:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p_x^2, 4p_y^2, 4p_z^1$.

(v) A salt bridge maintains the electrical neutrality in the cell. Give reasons to support your answer.

Ans A salt bridge is a U-tube containing saturated solutions of strong electrolytes, *e.g.*, KCl, KNO_3. It connects the two electrolytic solution. When electrochemical reaction takes place in the cell, it allows the passage of negative ions from the cathode compartment to anode compartment. As a result of that both compartments become neutral.

(vi) Calculate the oxidation numbers of the elements underlined in the following compounds:

(i) $K_2\underline{Mn}O_4$ (ii) $Ca(\underline{Cl}O_3)_2$

Ans (i) $K_2\underline{Mn}O_4$:

$$2(O.N \text{ of } K) + O.N \text{ of } Mn + 4(O.N \text{ of } O) = 0$$

$$2(+1) + Mn + 4(-2) = 0$$

$$2 + Mn - 8 = 0$$

$$\boxed{Mn = +6}$$

(ii) $Ca(\underline{Cl}O_3)_2$:

$$O.N \text{ of } Ca + (O.N \text{ of } Cl)_2 + 6(O.N \text{ of } O) = 0$$

$$+2 + 2Cl + 6(-2) = 0$$

$$2 + 2Cl - 12 = 0$$

$$2Cl = 10$$

$$Cl = \frac{10}{2}$$

$$\boxed{Cl = +5}$$

(vii) SHE acts as anode when connected with Cu electrode but as cathode with Zn electrode. Give reasons in support of your answer.

Ans SHE has electrode potential equal to zero. When it is coupled with Zn, Zn has low reduction potential and has 0.76 V more tendency than hydrogen to show oxidation and acts as anode. Hydrogen acts as cathode.

When Cu is coupled with hydrogen, Cu has high reduction potential and has 0.34 V more tendency than hydrogen to show reduction and acts as cathode. Then hydrogen acts as anode.

(viii) Define specific rate constant. Give equation to support your answer.

Ans **Specific Rate Constant:**

It states that the rate of reaction is proportional to the active mass of the reactant or to the product of active masses, if more than one reactants are involved in a chemical reaction.

Rate of reaction = $K[A]^a [B]^b$

(ix) Define autocatalysis. Give equation to support your answer.

Ans "In some reactions, a product formed acts as a catalyst. This phenomenon is called as autocatalysis."

Equation:

$$2KMnO_4 + 3H_2SO_4 + 5(COOH)_2 \xrightarrow{Mn^{2+}} K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$$

SECTION-II

NOTE: Attempt any Three (3) questions.

Q.5.(a) Serotenin (Molar mass = 176 g mol^{-1}) is a compound that conduct nerve impulse in brain and muscle. It contains 68.2% C, 6.86% H, 15.09% N and 9.08% O. What is its molecular formula? **(4)**

Ans **Given:** C = 68.2 %

H = 6.86 %

N = 15.09 %

O = 9.08 %

Dividing above %age by their atomic masses, we get mole ratios.

$$C = \frac{68.2}{12} = 5.68$$

$$H = \frac{6.86}{1.008} = 6.80$$

$$N = \frac{15.09}{14} = 1.08$$

$$O = \frac{9.08}{16} = 0.57$$

Dividing above mole ratios with least value, we get atomic ratio.

$$C = \frac{5.68}{0.5} = 9.96$$

$$H = \frac{6.80}{0.57} = 12.0$$

$$N = \frac{1.08}{0.57} = 1.89$$

$$O = \frac{0.57}{0.57} = 1$$

After rounding of the atomic ratio, write atomic ratios of elements below their symbols. So, the empirical formula is $C_{10}H_{12}N_2O$.

Empirical formula mass = 10C + 12H + 2N + O

= 120 + 12 + 28 + 16

= 176 g mol^{-1}

So, $$n = \frac{\text{Molecular mass}}{\text{Empirical mass}}$$

Putting the values

$$n = \frac{176 \text{ g mol}^{-1}}{176 \text{ g mol}^{-1}}$$

= 1

Multiply empirical formula by value of 'n'. We shall get molecular formula.

Molecular formula = n × empirical formula

= 1 × ($C_{10}H_{12}N_2O$)

$= \boxed{C_{10}H_{12}N_2O}$

(b) Write down any four properties of molecular solids. (4)

Ans **Properties of the Molecular Solids:**

(i) X-ray analysis has shown the regular arrangements of atoms in constituent molecules of these solids, and we get the exact positions of all the atoms.

(ii) The forces, which hold the molecules together in molecular crystals, are very weak. So, they are soft and easily compressible.

(iii) They are mostly volatile and have low melting and boiling points. They are bad conductors of electricity, have low densities and sometimes transparent to light. Polar molecular crystals are mostly soluble in polar solvents, while non-polar molecular crystals are usually soluble in non-polar solvents.

(iv) Iodine is one of the best examples of a molecular solid.

Q.6.(a) Derive Boyle's law and Charles's law from kinetic equation. (4)

Ans **Boyle's Law:**

In Boyle's law, the pressure and volume are variables, while the temperature and quantity of a gas remains constant. Boyle's law is stated as follows:

The volume of a given mass of a gas at constant temperature is inversely proportional to the pressure applied to the gas.

So, $V \propto \frac{1}{P}$

(when the temperature and number of moles are constant.)

or $V = \frac{k}{P}$

$PV = k$ (when T and n are constant.) (1)

'k' is proportionality constant. The value of k is different for the different amounts of the same gas.

According to the equation (1), Boyle's law can also be defined as "The product of pressure and volume of a fixed amount of a gas at constant temperature is a constant quantity."

So, $P_1V_1 = k$ and $P_2V_2 = k$

Hence, $P_1V_1 = P_2V_2$

P_1V_1 are the initial values of pressure and volume, while P_2V_2 are the final values of pressure and volume.

Charles' Law:

It is a quantitative relationship between temperature and volume of a gas and was given by French scientist J. Charles in 1787. According to this law, "The volume of the given mass of a gas is directly proportional to the absolute temperature when the pressure is kept constant."

$$V \propto T$$

(when pressure and number of moles are constant)

$$V = kT$$

$$\frac{V}{T} = k$$

If the temperature is changed from T_1 to T_2 and volume changes from V_1 to V_2, then,

$$\frac{V_1}{T_1} = k \quad \text{and} \quad \frac{V_2}{T_2} = k$$

So,
$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad (2)$$

The ratio of volume to temperature remains constant for same amount of gas at same pressure.

(b) Describe J.J. Thomson's experiment for determining e/m value of electron. (4)

Ans In 1897, J.J. Thomson devised an instrument to measure the e/m value of electron. The apparatus consists of a discharge tube shown in Fig.

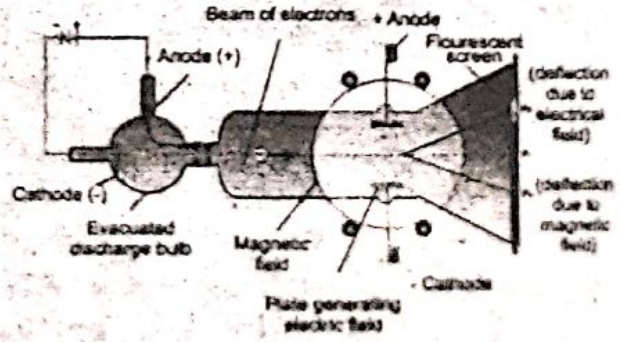

Fig. Measurement of e/m value of an electron.

The cathode rays are allowed to pass through electric and magnetic fields. When both the fields are off then a beam of

cathode rays, consisted of electrons, produces bright luminous spot at P_1 on the fluorescent screen. The north and south poles of magnetic field are perpendicular to the plane of paper in the diagram. The electrical field is in the plane of paper. When only magnetic field is applied, the cathode rays are deflected in a circular path and fall at the point P_3. When only electric field is applied, the cathode rays produce a spot at P_2. Both electric and magnetic fields are then applied simultaneously and their strengths adjusted in such a way that cathode rays again hit the point P_1.

In this way, by comparing the strengths of the two fields, one can determine the e/m value of electrons. It comes out to be 1.7588×10^{11} coulombs kg^{-1}. This means that 1 kg of electrons have 1.7588×10^{11} coulombs of charge.

Q.7.(a) Define dipole-moment. Give its units. How is it used to determine the geometry of molecule by an example? (4)

Ans The product of the magnitude of the charge positive or negative and the distance between them is called dipole moment.

Mathematically,

$\mu = q \times r$

where μ (mu) = dipole moment

q = charge

r = distance between the two positive and negative centres

Units:

(i) Debye (D)

(ii) meter-coulomb (mC)

$\boxed{1D = 3.336 \times 10^{-30}\ mC}$

Consider a molecule A–B, which is 100% ionic. A is full positive and B full negative. The bond length of this hypothetical molecule is supposed to be

$$1A^0 = 10^{-10}\ m$$

So, dipole moment for such molecule is

$$\mu = 1.6022 \times 10^{-19}\ C \times 10^{-10}\ m$$
$$= 1.6022 \times 10^{-29}\ mC$$

Relationship:

$$3.336 \times 10^{-30}\ mC = 1D$$

$$1\ \text{“}\quad\text{“}\quad\text{“} = \frac{1}{3.336 \times 10^{-30}\ mC}$$

$$1.602 \times 10^{-29}\ mC = \frac{1.6022 \times 10^{-29}\ mC}{3.336 \times 10^{-30}\ mC} = 4.8\ D$$

Heteroatomic molecules like HCl etc. become polar due to difference in electronegativity. The polarity is created on the bonded atoms. The degree of activity of a molecule is expressed in terms of dipole moment. It is a vector quantity having magnitude and direction from positive to negative end of dipole. Length of the arrow indicates magnitude of dipole moment. Non-polar molecules have zero dipole moment.

In case of polyatomic molecules, the net dipole moment is the resultant of vector addition of dipole moments of different bonds.

(b) State Hess's law. Explain it giving two examples. (4)

Ans For Answer see Paper 2016 (Group-II), Q.7.(b).

Q.8.(a) State Le-Chatelier's principle. How is this principle used to explain effect of change in concentration on a reaction at equilibrium state? (4)

Ans **The Le-Chatelier's Principle:**

Le-Chatelier studied the effects of concentration, pressure and temperature on equilibria.

This principle states that if a stress is applied to a system at equilibrium, the system acts in such a way so as to nullify, as far as possible, the effect of that stress.

Effect of Change in Concentration:

In order to understand the effect of change in concentration on the reversible reaction, consider the reaction in which $BiCl_3$ reacts with water to give a white insoluble compound $BiOCl$.

$$BiCl_3 + H_2O \rightleftharpoons BiOCl + 2HCl$$

The equilibrium constant expression for above reaction can be written as:

$$K_C = \frac{[BiOCl][HCl]^2}{[BiCl_3][H_2O]}$$

Aqueous solution of $BiCl_3$ is cloudy, because of hydrolysis and formation of BiOCl. If a small amount of HCl is added to this solution, it will disturb the equilibrium and force the system to move in such a way, so that effect of addition of HCl is minimized. The reaction will move in the backward direction to restore the equilibrium again and a clear solution, will be obtained. However, if water is added to the above solution the system will move in the forward direction and the solution will again become cloudy. The shifting of reaction to forward and backward direction by disturbing the concentration is just according to Le-Chatelier's principle.

So, in general, we conclude that addition of a substance among the reactants, or the removal of a substance among the products at equilibrium stage disturbs the equilibrium position and reaction is shifted to forward direction. Similarly, the addition of a substance among the products or the removal of a substance among the reactants will derive the equilibrium towards the backward direction. Removing one of the products formed can, therefore, increase the yield of a reversible reaction. The value of K_c, however, remains constant. This concept is extensively applied in common ion effect and follows the Le-Chatelier's principle.

(b) Define electrochemical series and give any two applications of it. (4)

Ans For Answer see Paper 2016 (Group-II), Q.9.(b).

Q.9.(a) The freezing point of pure camphor is 178.4°C. Find the freezing point of a solution containing 2.0 g of a non-volatile compound, having molecular mass 140, in 40 g of camphor. The molal freezing point constant of camphor is 37.7°C kg mol^{-1}. (4)

Ans

Freezing point of camphor	= 178.4°C
Mass of solute (W_2)	= 2.00 g
Mass of solvent (W_1)	= 40 g
Molar mass of solute (M_2)	= 140
Molal freezing point constant of solvent	= 37.7° C kg mol^{-1}
Freezing point of solution	= ?

Applying the equation

$$\Delta T_f = K_f \frac{1000\ W_2}{W_1 \times M_2}$$

We have to calculate, the freezing point of solution, so first we get the depression in freezing point ΔT_f, then subtract it from freezing point of pure solvent.

$$\Delta T_f = \frac{37.7 \times 1000 \times 2}{40 \times 140} = 13.46^\circ C$$

Freezing point of solution = 178.4 – 13.46 = **164.94°C**

(b) What are enzymes? Mention the characteristics of enzyme catalysis. (4)

Ans Enzymes are the complex protein molecules and catalyze the organic reactions in the living cells. Many enzymes have been identified and obtained in the pure crystalline state. However, the first enzyme was prepared in the laboratory in 1969. For example:

(i) Urea undergoes hydrolysis into NH_3 and CO_2 in the presence of enzyme urease present in soyabean.

$$H_2N-\overset{\overset{O}{\|}}{C}-NH_2 + H_2O \xrightarrow{\text{Urease}} 2NH_3 + CO_2$$

(ii) Concentrated sugar solution undergoes hydrolysis into glucose and fructose by an enzyme called invertase, present in the yeast.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} C_6H_{12}O_6 + C_6H_{12}O_6$$

(iii) Glucose is converted into ethanol by the enzyme zymase present in the yeast.

$$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + 2CO_2$$

Enzymes have active centres on their surfaces. The molecules of a substrate fit into their cavities just as a key fits into a lock, as in Fig. The substrate molecules enter the cavities, form the complex, reactants and the products get out of the cavity immediately.

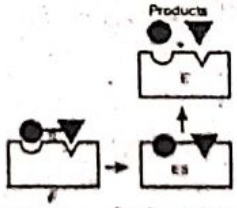

Fig. Lock and Key model of enzyme catalysis.

Michaulis and Menter (1913) proposed the following mechanism for enzyme catalysis

$$E + S \rightleftharpoons ES \longrightarrow P + E$$

Where E = enzyme, S = substrate (reactant)
ES = activated complex, P = product

Characteristics of Enzyme Catalysis:

The role of enzyme as catalysts is like inorganic heterogeneous catalysts. They are unique in their efficiency and have a high degree of specificity. For example:

(i) Enzymes are the most efficient catalysts known and they lower the energy of activation of a reaction.

(ii) Enzymes catalysis is highly specific, for example, urease catalyses the hydrolysis of urea only and it cannot hydrolyse any other amide even methyl urea.

(iii) Enzyme catalytic reactions have the maximum rates at an optimum temperature.

(iv) The pH of the system also controls the rates of the enzyme catalysed reaction and the rate passes through a maximum at a particular pH, known as an optimum pH. The activity of enzyme catalyst is inhibited by a poison.

(v) The catalytic activity of enzymes is greatly enhanced by the presence of a co-enzyme or activator.